Utilization of Rice Husk Waste and Gliricidia to Pink Oyster Mushroom Production and Nutritional Content

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Abstract. Pink oyster mushroom has economic value, non-cholesterol food source and high nutrition. Gliricidia leaves and rice husks are abundantly available in nature, but not utilized optimally yet. They contain nutrients for the growth and development of pink oyster mushrooms. This study aims to determine effect of gliricidia leaves and rice husks as additional supplements to growing media on the growth, yield, and nutritional content of pink oyster mushrooms. The study used completely randomized simple design consisting of six treatments, repeated four times. The treatments consisted of control, 150 g rice husk + 30 g gliricidia leaves; 120 g rice husk + 60 g gliricidia; 90 g rice husk + 90 g gliricidia; 60 g rice husk + 120 g gliricidia; 30 g rice husk + 150 g gliricidia. The data were analyzed using analysis of variance with F test. The results showed addition of gliricidia leaves and rice waste in form of rice husks as additional supplements to pink oyster mushroom growing medium was able to increase production by 2.2 times or 120%; increase the nutritional value of mushrooms as indicated by an increase in protein, ash, and water content; and reduced fat content.

Keywords: Healthy food, edible mushroom, Pleurotus djamor supplements, waste utilization

1 Introduction

Pink oyster mushroom (Pleurotus djamor (Rumph. ex Fr.) Boedijn) as a food source is starting to be in great demand by the public, because it is delicious, high in nutritional content, and has a beautiful pink color. The types of protein contained include lysine, methionine, tryptophan, theonin, valine, leucine, isoleucine, histidine, and phenylalanine. Mushrooms also contain several vitamins, including B1, B2, niacin, and biotin. In addition to vitamins, pink oyster mushrooms also contain several types of minerals, namely K, P,
Ca, Fe, Na, Mg, Mn, Zn, and Cu [1]. Pink oyster mushroom is reported to be able to treat various diseases because it contains natural antioxidants [2]. The presence of several compounds, such as ascorbic acid, tocopherol, carotene, and phenolic compounds is an indication that mushrooms have antioxidant properties [3]. The growth of pink oyster mushroom mycelium is influenced by physical factors such as temperature, humidity, light, pH of the growing media, and aeration. Mycelium growth of pink oyster mushroom between 17 d to 26 d [4, 5]. Oyster mushrooms can produce fruit bodies optimally in the temperature range of 26 °C to 28 °C, while mycelium growth reaches optimal growth at a temperature of 28 °C to 30 °C [6].

Gliricidia (Gliricidia sepium (Jacq.) Kunth ex Walp.) is one of the most important multipurpose legume species besides lamtoro (Leucaena leucocephala (Lam.) de Wit). Shrub-shaped from relatives of legumes. Gliricidia are often used as hedges or shade plants. Rao et al. [7] stated that gliricidia leaves contain high enough nitrogen with a C/N ratio of 12.075, making it easier for this plant biomass to decompose. Rice husk waste is a by product of the rice milling process and agricultural waste that is still not utilized optimally. Rice husk contains a large amount of carbon in the form of cellulose. Rice husk has a fairly high carbohydrate content with cellulose as the main constituent. Cellulose is the main constituent of wood which is white and insoluble in water or organic solvents [8]. About 20 % of the weight of rice is rice husk [9].

The aim of the study was to study the effect of adding rice husk and gliricidia leaf waste as a mixture of growing media on the production and nutritional content of pink oyster mushrooms.

2 Methods

The experiment was carried out at the Production Unit of the Center for Biotechnology Development, University of Muhammadiyah Malang. The experiment used a simple Completely Randomized Design (CRD) with six treatments, repeated four times. Each replication used five samples. The treatments consisted of: M0 = control (without the addition of rice husks and gliricidia leaves); M1 = 150 g rice husk + 30 g gliricidia leaves; M2 = 120 g rice husk + 60 g gliricidia leaves; M3 = 90 g rice husk + 90 g gliricidia leaves; M4 = 60 g rice husk + 120 g gliricidia leaves; and M5 = 30 g rice husk + 150 g gliricidia leaves.

Each baglog of mushroom growing media weighs 900 g. The materials used in addition to gliricidia leaves and rice husk waste were sawdust, rice bran, lime, corn flour, SP-36, and 65 % water which had been sterilized [10]. Observation variables included mycelium growth, number of fruit caps, diameter of fruit caps, thickness of fruit caps, fresh weight of pink oyster mushrooms, and their nutritional content. Testing the nutritional content of pink oyster mushroom was carried out by conducting a proximate test of the best treatment and standard media treatment (without giving rice husks and gliricidia leaves). The test was carried out at the nutrition laboratory of the University of Muhammadiyah Malang. The data obtained were analyzed statistically with analysis of variance and F test at 5 % and 1 % levels. To find out the difference in the mean value of the treatment, it was continued by Duncan’s test at 5 % level.

3 Results and discussion

3.1 Pink oyster mushroom growth and yield
Provision of rice husk and gliricidia leaf waste with various compositions had a significant effect on the growth and yield of pink oyster mushrooms. The average value of mycelium growth at 34 d after inoculation, number of mushroom caps, diameter of mushroom caps, thickness of caps, and fresh weight of mushrooms are shown in Table 1.

Table 1. Average values of several growth parameters and yields of pink oyster mushrooms due to the treatment of additional supplements of rice husk and gliricidia leaf waste.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mycelium growth (34 DAI)</th>
<th>Mushroom cap number</th>
<th>Mushroom cap diameter (cm)</th>
<th>Cap thickness (mm)</th>
<th>Mushroom fresh weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (M0)</td>
<td>19.8 c</td>
<td>25.4 c</td>
<td>6.3 b</td>
<td>2.4 a</td>
<td>66.6 a</td>
</tr>
<tr>
<td>150 g rice husk + 30 g gliricidia leaves (M1)</td>
<td>19.8 c</td>
<td>18.9 b</td>
<td>5.7 a</td>
<td>2.6 b</td>
<td>75.2 ab</td>
</tr>
<tr>
<td>120 g rice husk + 60 g gliricidia leaves (M2)</td>
<td>19.6 b</td>
<td>17.3 ab</td>
<td>6.3 b</td>
<td>2.8 cd</td>
<td>87.1 bc</td>
</tr>
<tr>
<td>90 g rice husk + 90 g gliricidia leaves (M3)</td>
<td>19.6 b</td>
<td>15.8 ab</td>
<td>6.4 bc</td>
<td>2.7 bc</td>
<td>101.0 c</td>
</tr>
<tr>
<td>60 g rice husk + 120 g gliricidia leaves (M4)</td>
<td>19.5 b</td>
<td>14.6 ab</td>
<td>6.9 c</td>
<td>2.9 d</td>
<td>136.3 d</td>
</tr>
<tr>
<td>30 g rice husk + 150 g gliricidia leaves (M5)</td>
<td>19.0 a</td>
<td>12.4 a</td>
<td>7.7 d</td>
<td>3.0 d</td>
<td>146.6 d</td>
</tr>
</tbody>
</table>

Note: numbers with the same letter in the same column show a significant difference according to Duncan’s test level 5%. DAI = Days After Inoculation.

Table 1 shows that pink oyster mushrooms on standard media (control) without rice husks and gliricidia leaves had a faster mycelium growth than on media with rice husks and gliricidia leaves. Mycelium growth at 34 d after inoculation (HSI) was slowest on media that was given 30 g of rice husk and 150 g of gliricidia leaves. Giving more gliricidia leaves caused slower mycelium growth. It is suspected that the nutrients available in baglog media require a longer time to remodel the nutrients available in the media to become simpler nutrients, making it easier for the mycelium to absorb the nutrients available in baglog media.

The addition of rice husks to the mushroom growing medium can help the mycelium to grow properly because rice husks contain crude fiber, namely lignin, cellulose, and hemicellulose. Rice husk waste, rice straw, sawdust, banana stems, corn stalks and leaves and other agricultural wastes that contain fiber can provide high production. The growing medium for mushrooms should be slightly rough so that they are not easy to condense so that they do not inhibit the mycelium growth space [11, 12]. Other researchers stated that the average growth rate of oyster mushroom mycelium on the substrate showed a tendency to increase with increasing rice husk concentration. The highest fresh weight and maximum biological efficiency of pink oyster mushrooms is obtained by using rice waste growing media, rice straw [13, 14].

Mycelium thickness on standard media (control), without rice husks and gliricidia leaves and media with the addition of 150 g rice husks + 30 g gliricidia leaves was the treatment that had the best mycelium thickness, which was characterized by thick and dense mycelium growth. Thick mycelium growth indicates that the fungus seeds can utilize the nutrients available in the media optimally. Good mycelium growth is characterized by fungal mycelium that looks cottony white, dense, and grows attached to the growing medium.

The treatment of giving rice husks and gliricidia leaves to the number of mushroom caps showed the highest results on standard media (control) without rice husk and gliricidia leaf supplements. This is influenced by the nutrients available in standard media which are
not too many so that the fruiting bodies that grow can only produce a large number of caps but with small sizes or relatively small diameters. On the other hand, the media that was given 30 g of rice husk + 150 g of gliricidia leaves produced the least number of hoods, but large size/widest mushroom cap diameter. The addition of more gliricidia leaves caused the number of caps produced to be less because the nutrients available in the media were more optimally absorbed for the growth process of diameter and fresh weight of the hood, so that the diameter and fresh weight produced were better than the growth of the number of pink oyster mushroom caps. The mushroom cap that grows depends on the number of fruit bodies in one clump [15].

Physical qualities such as the number of hoods, the diameter of the hood and the fresh weight of the resulting oyster mushroom growth were influenced by the use of different compositions of growing media [16]. Oyster mushrooms which have a relatively smaller diameter will produce a relatively larger number of hoods [14].

Pink oyster mushroom on media that was given 30 g of rice husk and 150 g of gliricidia leaves produced fruit bodies with the best diameter and thickness of the hood compared to other treatments. It is suspected that the media given 30 g of rice husks and 150 g of gliricidia leaves had more available nutrients, which were needed for the formation of pink oyster mushroom fruit bodies. Leaves decompose more easily than sawdust or rice husks. The media without rice husk and gliricidia leaf added had a smaller average diameter and thickness of the hood compared to the media with rice husk and gliricidia leaves added. The number of fruit hoods produced is quite a lot so that the growth is crowded and becomes not optimal.

The less number of mushroom hoods in one clump, the larger the diameter of the hood that will grow in one mushroom clump [14]. The growth of the diameter of the red oyster mushroom hood can also be influenced by the absorption of nutrients and the availability of nutrients contained in the mushroom media. The width of the diameter of the mushroom hood is influenced by the availability of nutrients contained in the mushroom media [11]. A small number of fruit bodies generally have a large size, because the fungus is able to carry out maximum vegetative growth. The more the number of hoods, the thickness of the hood will be thinner/smaller. This causes the growth of the formation of the thickness of the hood to be less than the maximum. Mushrooms grow in one clump, where if in one clump of mushroom hoods that grow a lot, it will affect the diameter and thickness of the hood which is getting smaller, on the contrary if in one clump the mushroom hood grows a little it will affect the diameter and thickness of the hood which is getting wider [17].

The highest fresh weight of pink oyster mushroom resulted from media treatment with the addition of 30 g rice husk + 150 g gliricidia leaves. On the other hand, standard media without rice husk and gliricidia leaves (control) produced relatively low fresh weight. This shows that the standard media (control) did not get additional nutrients like other treatments which were given additional nutrients from gliricidia leaves and rice husks. Initially, the available nutrients are absorbed by the mycelium and remodeled for the primordial growth process of the mushroom fruiting bodies. Nutrients that are absorbed by the mushrooms will be able to increase the fresh weight of the mushrooms. Gliricidia leaves contain high nitrogen, while rice husks contain high carbohydrates, where cellulose compounds are the main constituent. Cellulose is the main constituent of wood which is white in color and insoluble in water and in organic solvents [18]. The compounds found in gliricidia leaves and rice husks will be broken down into simpler compounds so that they are more easily absorbed by fungi. The addition of nutrients to the media can help stimulate the growth of fungi. Nutrients added to the pink oyster mushroom growing medium which can be absorbed maximally can increase the fresh weight of the mushroom [19].
3.2 Pink oyster mushroom nutrient contents

The results of the proximate analysis of pink oyster mushrooms due to the treatment of additional supplements of rice husks and gliricidia leaves are presented in Table 2.

**Table 2.** Proximate analysis results.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Water content (%)</th>
<th>Ash (%)</th>
<th>Protein (%)</th>
<th>Crude fat (%)</th>
<th>Crude fiber (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard media, without the addition of rice husks and gliricidia leaves</td>
<td>88.48</td>
<td>7.58</td>
<td>25.09</td>
<td>0.93</td>
<td>32.43</td>
</tr>
<tr>
<td>Media with the addition of 30 g rice husk + 150 g gliricidia leaves</td>
<td>91.39</td>
<td>8.12</td>
<td>38.89</td>
<td>0.73</td>
<td>27.66</td>
</tr>
</tbody>
</table>

Table 2 shows that the growing medium of pink oyster mushroom which was given 30 g of rice husk and 150 g of gliricidia leaf as an additional supplement was able to increase its protein content, water content, and ash content. On the other hand, the fat and crude fiber content decreased. This proves that the administration of 30 g of rice husks and 150 g of gliricidia leaves on the growing media effectively increases the nutrient content needed for the growth and development of pink oyster mushrooms.

Other researchers reported that the addition of 2 % rice husk to the substrate showed a significant increase in fat, ash and carbohydrate content compared to the control. Likewise, the main mineral constituents such as Ca and P become better [13]. Gliricidia leaves contain nutrients Nitrogen (N) which is quite high at 2.4 %; Phosphorus (P) of 0.1 %; Potassium (K) 1.8 %; Calcium (Ca) and Magnesium (Mg) [20], making it suitable as an additional supplement in mushroom cultivation.

4 Conclusion

The addition of rice husk waste and gliricidia leaves as additional supplements significantly affected the growth and yield of pink oyster mushrooms. Mushroom growing media supplemented with 30 g rice husk + 150 g gliricidia leaves showed the best results on fruit cap thickness, cap diameter, and fresh weight of pink oyster mushroom. The production of pink oyster mushrooms increased from 66.6 g to 146.6 g or an increase of 120 %. The addition of a supplement of 30 g rice husk + 150 g gliricidia leaves also increased the nutritional content of pink oyster mushrooms. The protein content has increased from 25 % to 39 %. Meanwhile, the fat content decreased from 0.9 % to 0.7 %.

References


